Energy-momentum conserving algorithm for nonlinear dynamics of laminated shells based on a third-order shear deformation theory

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Abstract: The paper describes an energy-momentum conserving time stepping algorithm for nonlinear dynamic analysis of laminated shell type structures undergoing finite rotations and large overall motion. The shell model is based on a third order shear deformation theory and falls within the class of geometrically exact shell theories. This algorithm is based on a general methodology for the design of exact energy-momentum conserving algorithms proposed recently by Simo and Tarnow. It is second-order accurate, unconditionally stable, and preserves exactly, by design, the fundamental constants of the shell motion such as the total linear momentum, the total angular momentum, and the total energy in case the system is Hamiltonian. The finite element discretization of the present shell model is closely related to a recent work by the authors dealing with the static case. Particular attention is devoted to the consistent linearization of the weak form of the fully discretized initial boundary value problem in order to achieve quadratic rate of convergence typical of the Newton-Raphson solution procedure. A range of numerical examples is presented to demonstrate the performance of the proposed formulation. © ASCE.